PERFORMANCE EVALUATION OF A SOLID STATE MODULATOR

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Comprehensive two-dimensional gas chromatography (GC×GC) relies on the use of modulators that have the task to stop, focus, and re-inject the eluent of the first dimension (^{1}D) into the second dimension (^{2}D). Since the era of first phase-ratio modulator devices [1], flow modulators, and thermal modulators have emerged as more robust hardware. Nowadays, very efficient thermal modulators are mainly based on the use of cryogens (CO_2 and liquid N_2) that unfortunately increase operational costs to a point that might limit the widespread usage of GC×GC [2]. Consumable-free thermal modulators have thus appeared, with various levels of success [3]. Amongst them, the thermal independent modulator (TiM) proposed by Luong et al. [4] is based on a 3-stage thermoelectric cooling (TEC), a mica-thermic heating, and a movable capillary column. This modulator has been further improved with major changes on mechanical and electrical design as well as on the modulation column. This cryogen-free two-stage solid state modulator is mounted on the top of the GC oven, consequently heating and cooling are independent of the GC oven temperature. A modulation column passes through two hot-zones with a thermo-electric cooler (TEC) in between which serves a trapping zones. The moving design of the column allows to trap, release and re-trap compounds coming from ^{1}D before being released into ^{2}D.

The modulator was found to be useful for chromatographic applications over a volatility range equivalent to C_8 to C_{20} under used conditions. Repeatability of first and second dimension retention times (^1t_R and ^2t_R) for Grob mix compounds were found to be satisfactory with relative standard deviations (RSD%) ranging between 0.0001% and 0.0017% and between 0.0050% and 0.0312%, respectively. The RSD% for peak volumes ranged between 0.0290% and 0.2869% (n=16). Typical peak widths of 80 to 120 ms were achieved for the Grob mix compounds as well as for compounds of the more complex century mix [5]. Further testing on a perfume sample revealed similar results for peak width and repeatability.

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